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NAVY review completed.

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Subj: Capacitors, Non-Standard, MCN Nos. 18158, 18159, 18160, 18175, 18176, 18177, 18183, 18184, 18185, and 18186; Evaluation of (U)

[redacted]

Encl:
(1) Figure 1 - Capacitor MCN 18158 (C)
(2) Figure 2 - Capacitor MCN 18159 and 18160 (C)
(3) Figure 3 - Capacitor MCN 18183 (C)
(4) Figure 4 - Capacitor MCN 18184 (C)
(5) Figure 5 - Capacitor MCN 18185 (C)
(6) Figure 6 - Capacitor MCN 18175 and 18176 (C)
(7) Figure 7 - Capacitor MCN 18177 and 18186 (C)
(8) Figure 8 - Capacitor MCN 18177 (C)
(9) Test Procedures (C)
(10) Test Results (C)

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2. [redacted] 10 groups of capacitors, each group represented by 1 or 2 samples so as to make a total of 13 samples. Each group is identified by an MCN Part Number. Voltage and capacitance ratings are only provided for 3 groups, MCN Part Nos. 18158, 18159 and 18160. It was assumed [redacted] 25X1 that the above 3 groups 25X1 consisted of electrolytic capacitors and the remaining 7 groups were metallized paper capacitors. A count of the capacitor samples received at the Laboratory showed a total of 17 samples.

3. An inspection of the capacitor shipment received at the Laboratory revealed the following information:

a. The samples were packed in a corrugated cardboard box containing 10 envelopes. Each envelope contained 1 or more samples wrapped in paper. On the outside of each envelope were two numbers; one, in ink, corresponding

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to an MCN Part No. given in reference (a) and another, in crayon, corresponding to a number on a paper wrapping within the envelope. Each paper wrapping contained one or more capacitor samples 25X1

There were actually 2 samples in each of the 2 envelopes marked with MCN Part Nos. 18175 and 18176, respectively. The envelope bearing MCN Part No. 18177 contained 2 samples of one case configuration and 1 sample of another bringing the total to 17 samples.

b. No information as to capacitor ratings or application purposes was observed on the envelopes. Some information was observed. however, to be typewritten in German on the paper wrappings. The information covered the following items: 25X1

(1) The capacitor class (Electrolytic or Metallized), which was in agreement with that shown in reference (a) for each MCN Part No. 25X1

(2) The nominal capacitance (in MFD) for 8 of the 10 MCN Part Nos.

(3) The voltage level, in loose terminology, such as "low voltage" or "high voltage" for 2 MCN Part Nos.

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c. The capacitor samples are metallic cased units; the electrolytic samples being tubular with wire leads while the metallized paper samples include rectangular and cylindrical types with solder lug terminals, as well as tubular types with wireleads.

(1) MCN Part No. 18186, 1 sample

Nominal Capacitance	2 MFD
Temperature Range	25°C to +70°C

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(2) MCN Part No. 18177, 2 samples

Voltage	250 VDC and 125 VAC at 50 cps.
Temperature Range	-55°C to +85°C

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Dimensioned drawings representing the 8 capacitor case configurations encountered were then made, as suggested and are included with this report as enclosures (1) through (8). 25X1

5. The information shown in paragraph 3, above, was carefully collected and analyzed for use in planning test procedures. At this point it was considered that the lack of information regarding operating temperature ranges and voltage ratings for most of the capacitor samples made the performance of tests involving high and low temperatures or the application of rated or higher than rated voltages a risky undertaking, in view of the extremely limited number of samples representing each MCN Part Number. A supplemental study of available German DIN specification sheets was therefore initiated, based on the dimensional correspondence observed (using the metric system) between capacitors listed therein and those received at the Laboratory. A revised description of the capacitors received at the Laboratory, in the light of the information shown above is presented below:

M. L. Mkg	MCN Part No.	Cap. Class	Nom. Cap. MFD	Indicated Voltage	Indicated Temp. Range in °C
1 - 1	18158	Electr.	10	Low Voltage (6 VDC)	-
1 - 2	"	"	"	" "	-
2 - 1	18159	"	"	(15 VDC)	-
2 - 2	"	"	"	"	-
3 - 1	18160	"	"	"	-
3 - 2	"	"	"	"	-
4	18183	MP	2 X 0.5	250 VDC*	-40 to 70*
5	18184	"	0.5	160 VDC*	" " "*
6	18185	"	0.25	250 VDC*	" " "*
7	18186	"	2**	High Voltage, 500VDC*	-25 to + 70**
8 - 1	18175	"	2	250 VDC*	-
8 - 2	"	"	"	"*	-
9 - 1	18176	"	4	160 VDC*	-
9 - 2	"	"	"	"*	-
10- 1	18177	"	2	High Voltage, 500VDC*	-25 to + 70*
10- 2	"	"	1	250 VDC**	-55 to + 85**
10- 3	"	"	"	**	" " "**

NOTES: 1. All nominal capacitance values have been verified by Laboratory measurements.
2. Indicated voltages in brackets for electrolytic capacitors are tentative Laboratory ratings.

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3. * indicates information obtained from German DIN specification sheets.
4. ** indicates information obtained from visual inspection of capacitors.
5. - indicates no information available.

6. Test procedures were selected with the objective of determining ratings and relative quality of the capacitor samples [redacted] 25X1
[redacted] Specification MIL-C-62B, reference (b) (a revision of MIL-C-62A), and specification MIL-C-18312A (Navy), reference (c), are being used as guides in accomplishing this objective. [redacted] 25X1
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[redacted] it was essential to reserve any potentially destructive tests for the end of the test sequence. The test procedures selected are described in enclosure (9). Some repetition of tests for the electrolytic capacitor samples (see paragraph 5 of enclosure (9)) was made necessary by contradictions between the voltage and capacitance ratings indicated on the capacitor wrappings, the ratings shown in reference (a) and the results obtained using the test procedures of paragraphs 2, 3 and 4 of enclosure (9). 25X1

7. The results of the test procedures performed to date, with the exception of the initial visual inspection already reported in paragraph 3, are included as enclosure (10). Requirements of references (b) and (c) for capacitors with similar ratings are shown on enclosure (10) for comparison. Direct comparisons cannot be made in every case as references (b) and (c) did not always include capacitors with the same capacitance, voltage and temperature ratings as those received for evaluation.

8. It is estimated that a final report will be issued approximately May 1963.

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Figure 1
Capacitor MCN 18158

Enclosure 1

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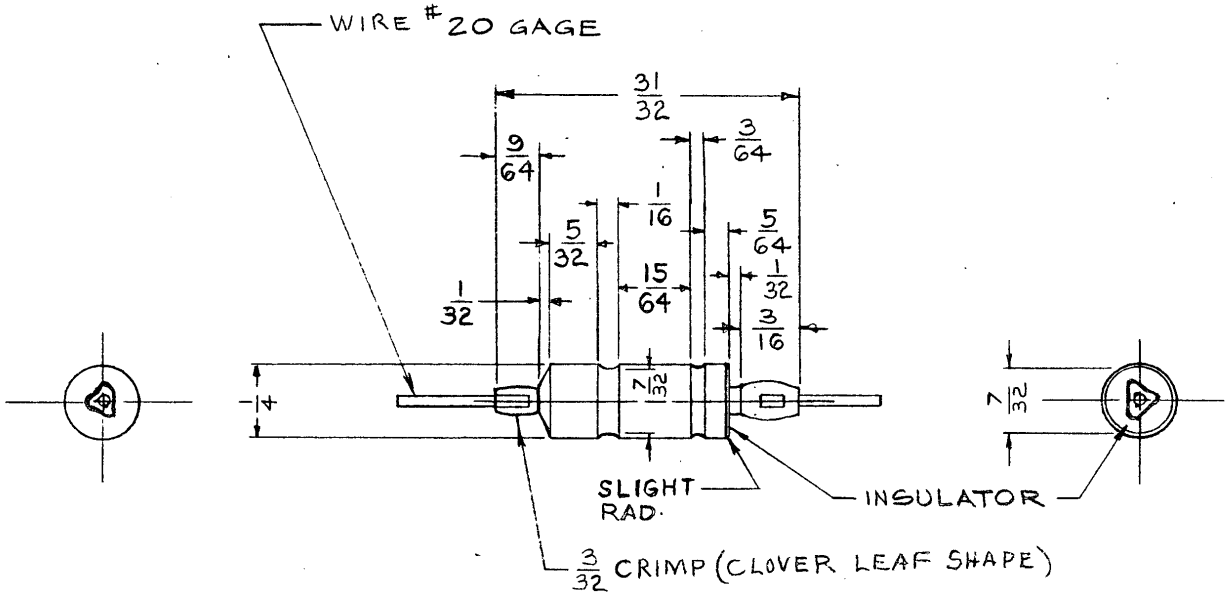

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Figure 2
Capacitors MCN 18159
And MCN 18160

Enclosure 2

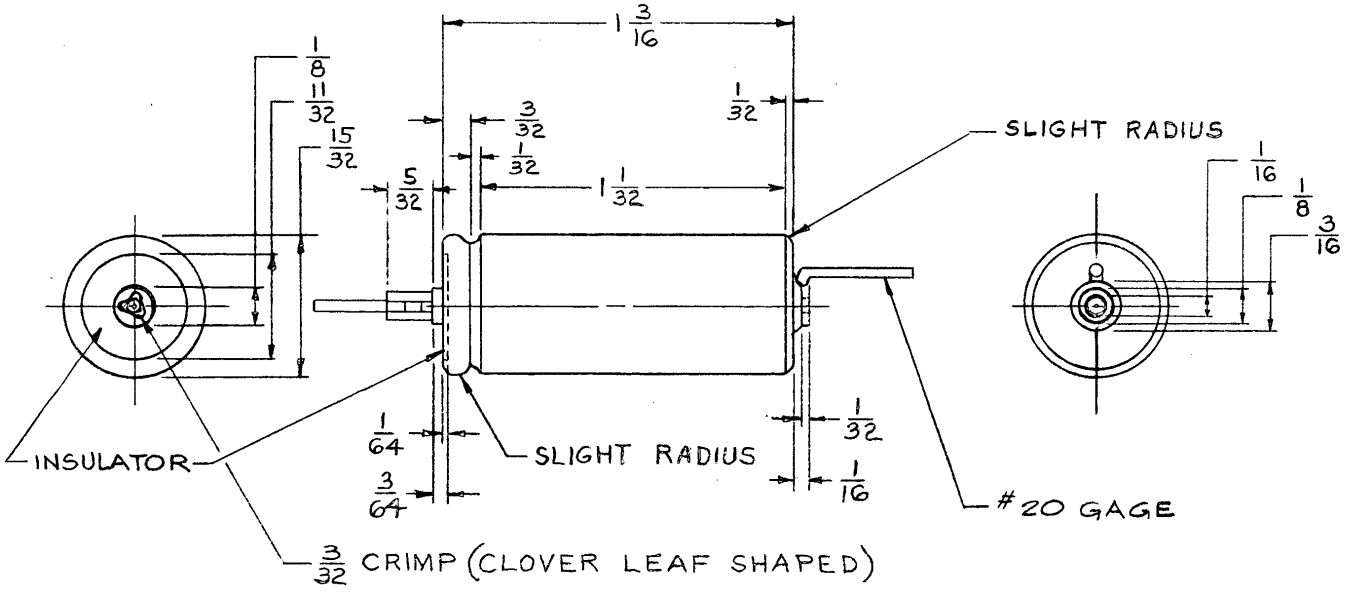

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Figure 3
Capacitor MCN 18183

Enclosure 3

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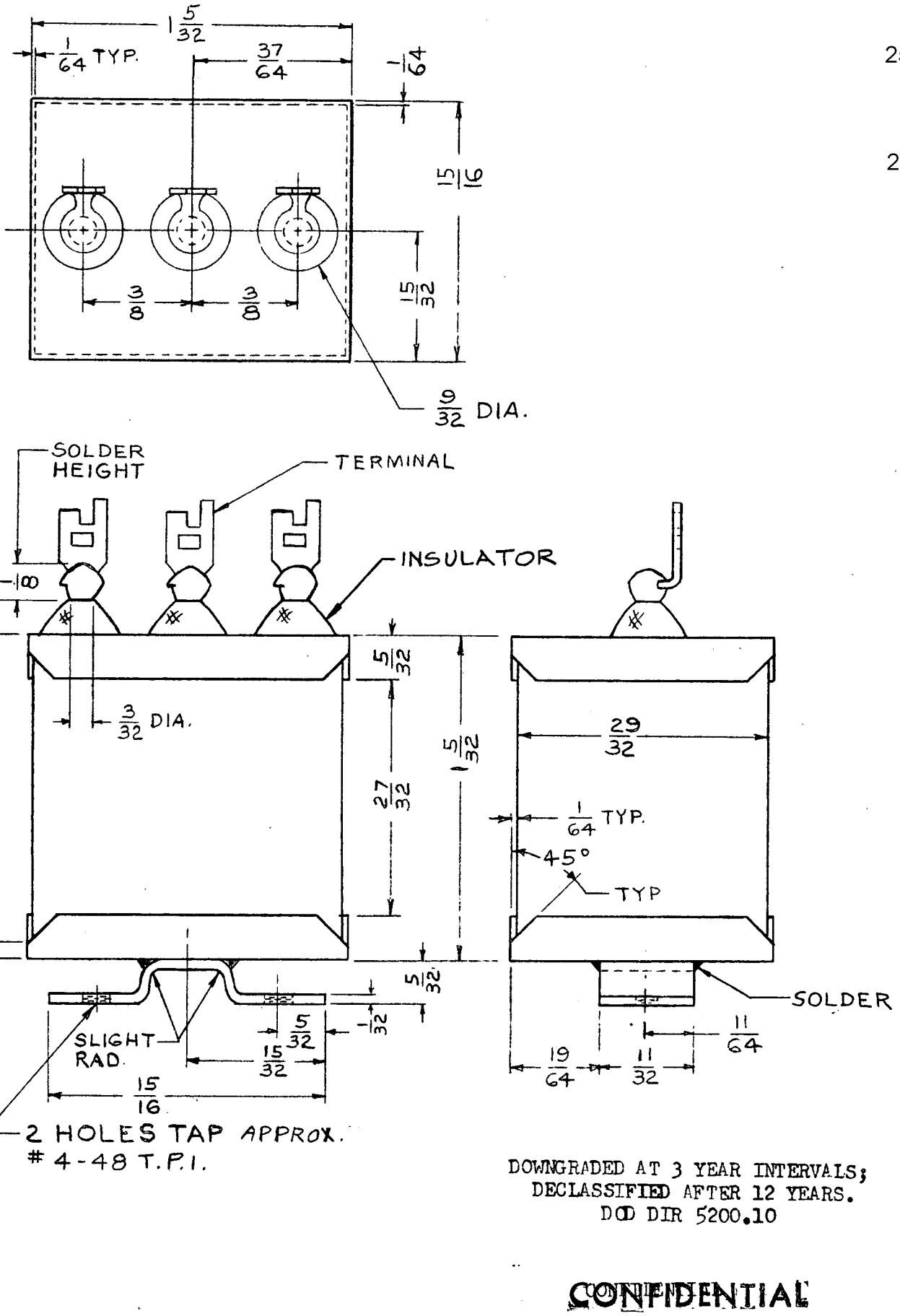

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Figure 4
Capacitor MCN 18184

Enclosure 4

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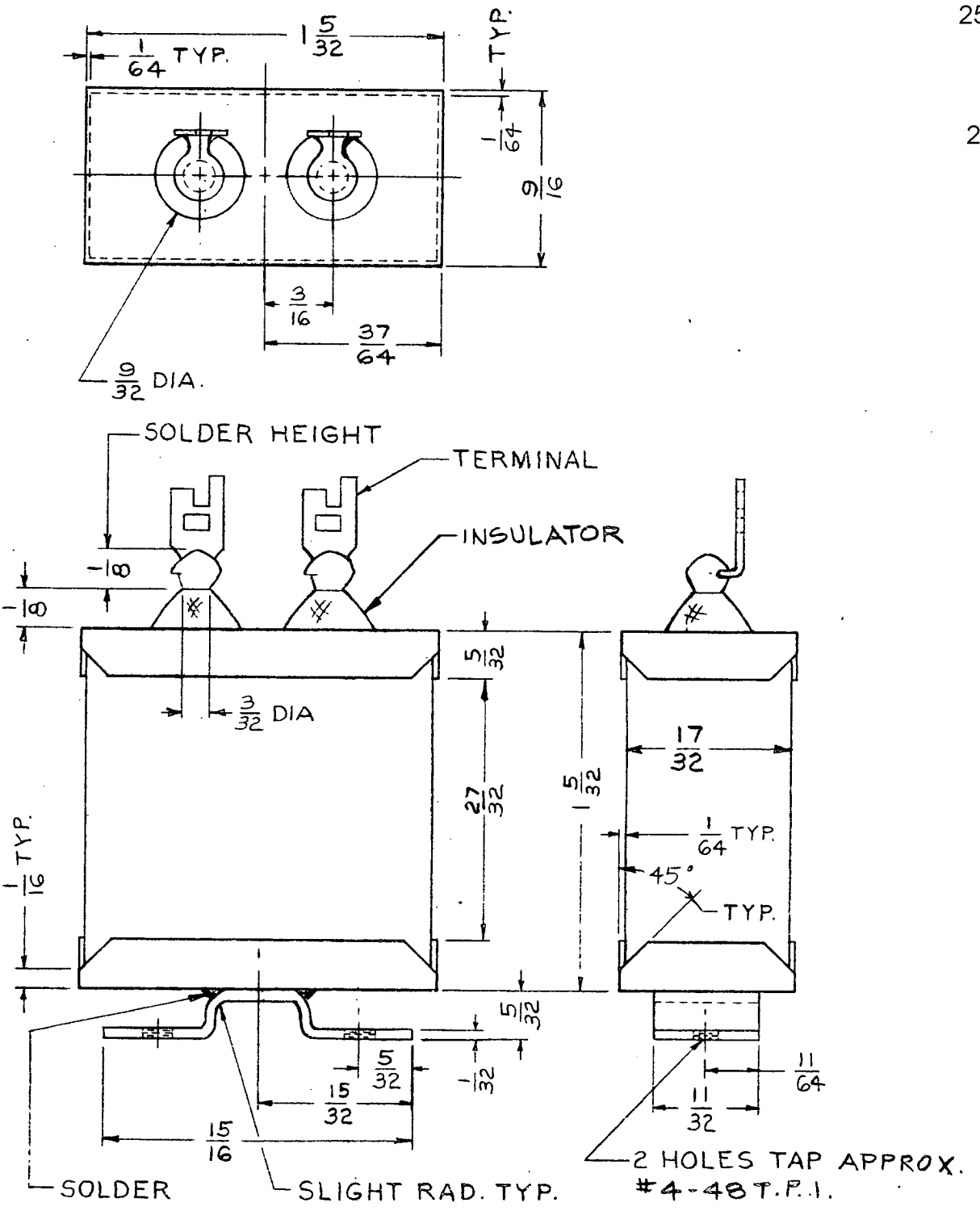

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Figure 5
Capacitor MCN 18185

Enclosure 5

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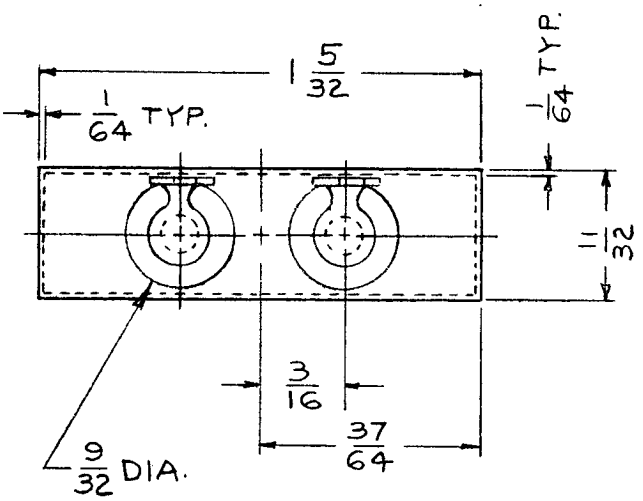

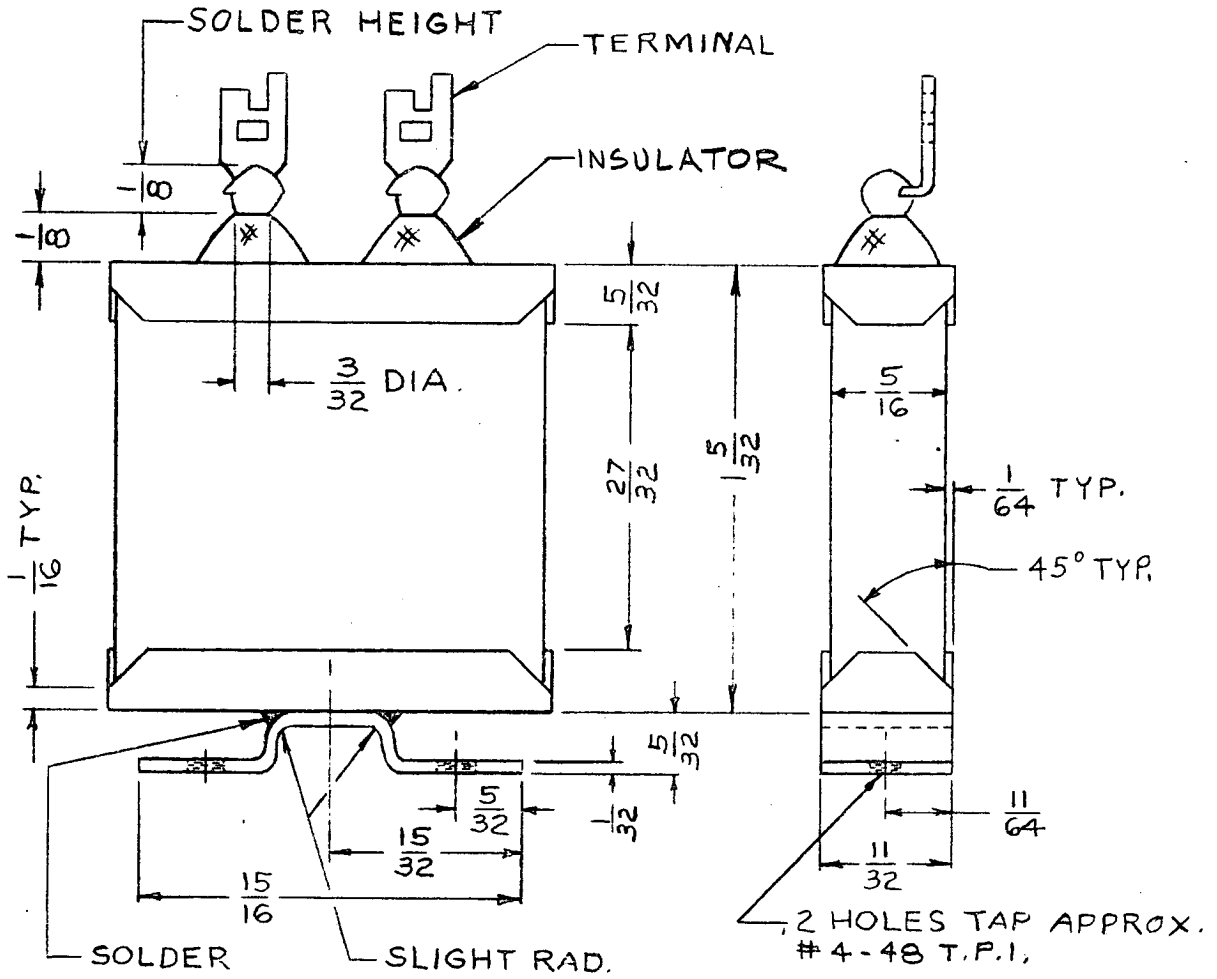

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Figure 6
Capacitors MCN 1817
And MCN 18176

Enclosure 6

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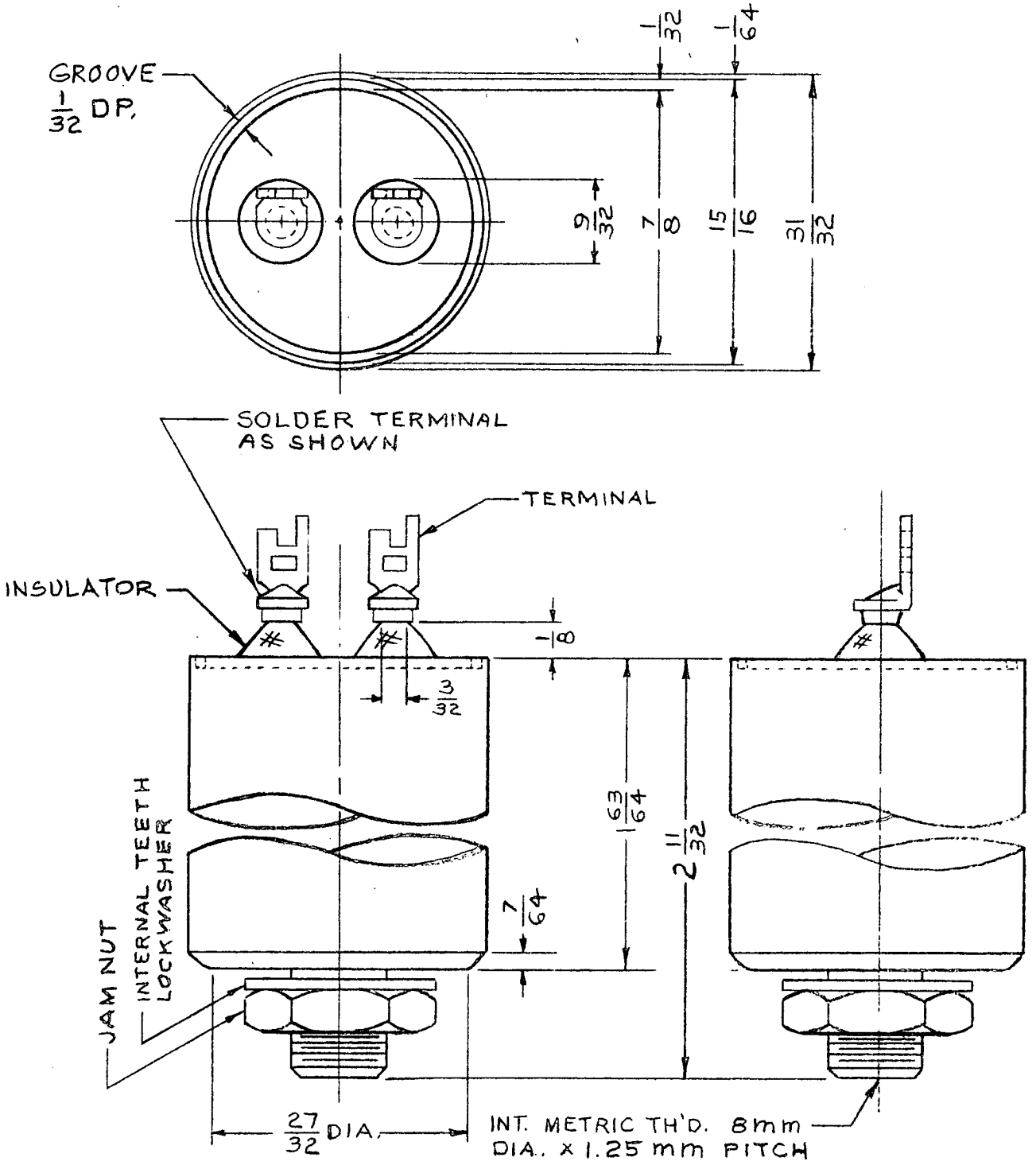

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Figure 7
Capacitors MCN 1817
And MCN 18186

Enclosure 7

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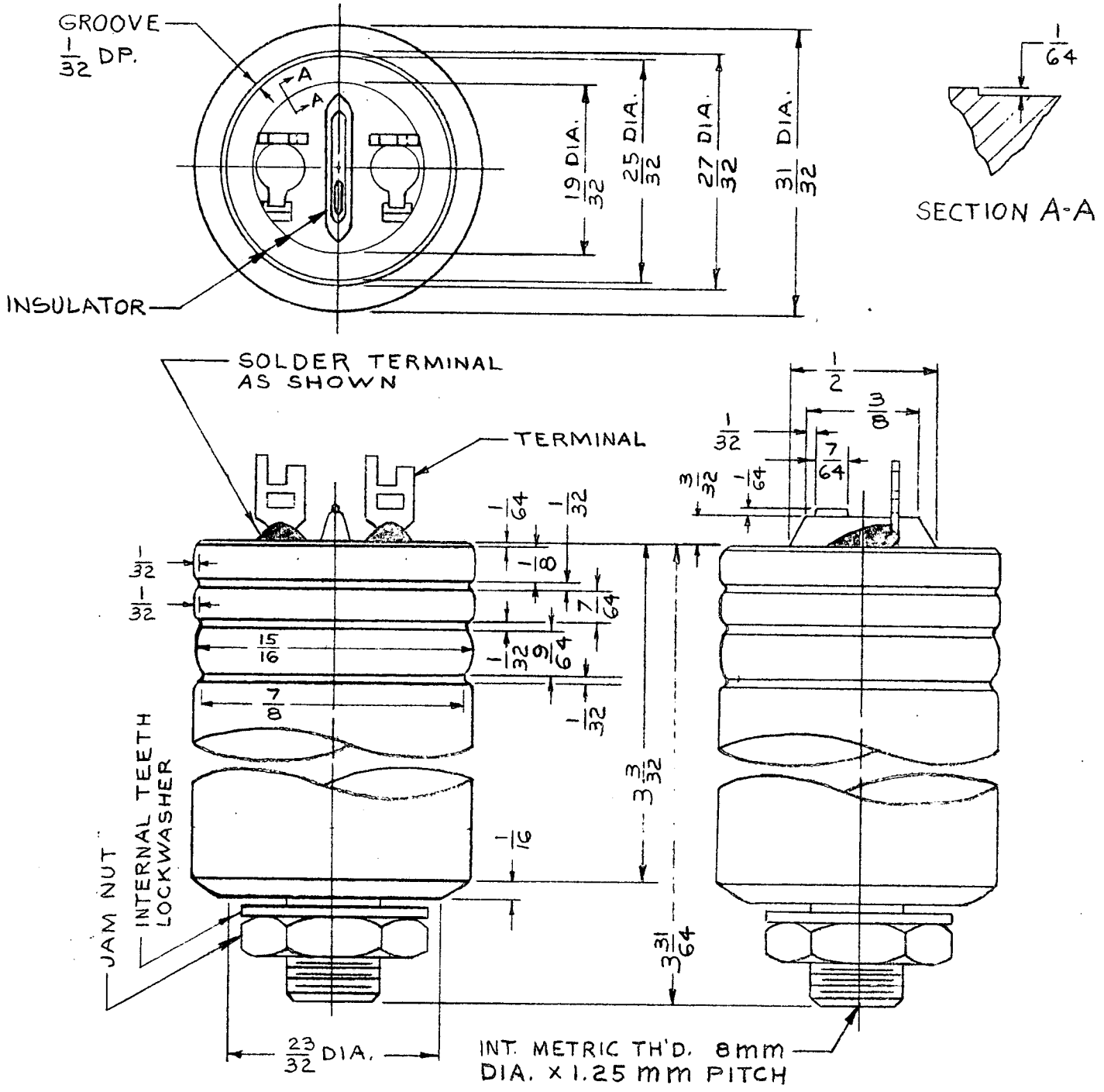

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Figure 8
Capacitor MCN 18177

Enclosure 8

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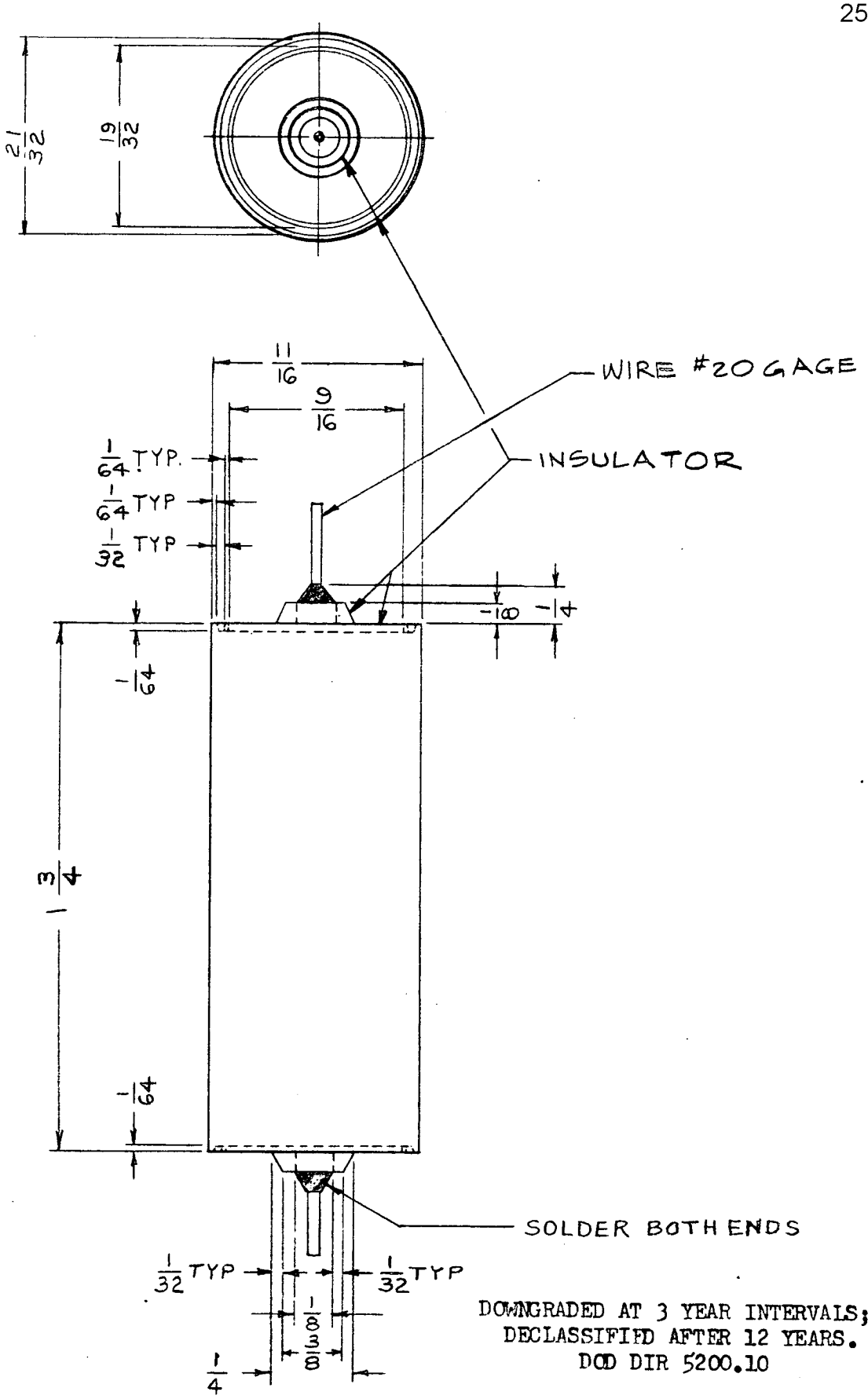

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TEST PROCEDURES

All Capacitor Specimens

1. The 17 capacitor specimens were subjected to an external visual examination. [redacted] 25X1 25X1

Electrolytic Capacitor Specimens
(MCN 18158, 18159, 18160)

2. All six capacitor specimens were first subjected to a dielectric film reforming procedure. This procedure involved an incremental increase in D.C. voltage applied to each specimen through a protective current limiting resistor until a value of 6 VDC was reached which was then maintained for 30 minutes. The leakage current was continuously monitored during this reforming procedure.

3. Twenty-four hours after reforming, the leakage currents of all six specimens were measured at 6 VDC using the procedure shown in reference (b).

4. Capacitance and dissipation factor measurements were then made on all six specimens in accordance with the procedures shown in reference (b) using a polarizing voltage of 6 VDC.

5. The results obtained (see enclosure (10)) from the leakage current, capacitance and dissipation factor procedures of paragraphs 3 and 4, above, led to the decision to repeat the reforming procedure on the capacitors designated as MCN 18159 and MCN 18160 using 15 VDC, wait 24 hours (unenergized), then measure their leakage currents at 15 VDC and their capacitances and dissipation factors using a polarizing voltage of 15 VDC.

6. All six capacitors will undergo stability tests at reduced and high temperatures using the procedures shown in reference (b) but with a high temperature of 65°C instead of 85°C. An applied voltage or polarizing voltage of 6 VDC will be used for MCN 18158 specimens and 15 VDC for MCN 18159 and MCN 18160 specimens. If the results of this procedure are satisfactory, it will be repeated using the high temperature of 85°C indicated in reference (b).

7. If any capacitor specimens meet the requirements of reference (b) upon completion of the test procedures of paragraph 6, above, they will be subjected to the 1500-hour life test shown in reference (b). In any event, the final test procedure will be a dissection and internal visual examination of one specimen of each MCN number to reveal any outstanding constructional features.

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Enclosure (9)
Page 2 of 3

Metallized Paper Capacitor Specimens
(MCN 18175, 18176, 18177, 18183, 18184, 18185, and 18186)

8. Capacitance and dissipation factor of specimens identified as MCN Part Nos. 18183, 18184 and 18185 were measured at a frequency of 1 kilocycle as their wrappings also carried capacitance marking below 1.0 MFD. Capacitance and dissipation factor of specimens identified as MCN 18175 and 18176 were measured at a frequency of 60 cycles as their wrappings were marked with capacitance values greater than 1.0 MFD. Capacitance and dissipation factor of the specimen identified as MCN 18186 were measured at a frequency of 60 cycles 25X1

Capacitance and dissipation factor of one specimen identified as MCN 18177 was also measured at a frequency of 60 cycles because of its identical size and appearance to the MCN 18186 specimen. Capacitance and dissipation factor of the other two specimens identified as MCN 18177 were measured at frequencies of 1 kilocycle and 60 cycles 25X1 25X1

9. Insulation resistance measurements were performed on all eleven specimens at 25°C using 50 VDC. This voltage was selected, on the basis of the results of the initial visual inspection and the information contained in paragraph 5 of this report, so as to be well below the probable minimum rated voltage of any of the capacitor specimens. Thus, the chance of momentary breakdown and healing of any capacitor specimen was kept to a minimum. 25X1

10. The next test procedure will consist of a series of measurements of capacitance, dissipation factor and insulation resistance on all eleven capacitors over a temperature range of -55°C to +100°C. These measurements will be made when the specimens have reached thermal stability at each of several temperatures in the following order:

a. 25°C
b. -55°C
c. 25°C
d. 65°C
e. 85°C
f. 100°C
g. 25°C

The temperature range selected is the narrower of the two listed in reference (c) and will help determine whether these capacitors compare favorably with what is currently available for Military use.

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11. Each of the specimens that have shown little or no sparking during the previous test procedures will then be subjected to an application of 150 VDC followed by incremental increases in DC voltage until sparking begins. Each successive voltage increment will be maintained for 1 minute or until sparking starts, whichever occurs first. A protective series resistor of 5,000 ohms will be used with each capacitor specimen during this test procedure.

12. If any capacitor specimens appear to have outstanding characteristics after the above sequence of tests they will be assigned a voltage rating and subjected to the low temperature and life test procedures listed in reference (c).

13. The final procedure will be a dissection and internal visual examination of one specimen of each of the six case configurations among the eleven specimens. One of the two MCN 18176 specimens which are physically similar to those identified as MCN 18175 specimens but have different measured capacitances (see enclosure (10)) will also be dissected and examined.

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Enclosure (10)
Sheet 1 of 2

TEST RESULTS
Electrolytic Capacitors
Initial Measurements

MCN Part No.	Mat. Lab. Specimen No.	First Set: 5 min Leakage Current ua	First Set: Cap. MFD	First Set: Dx %	Second Set: 5 min. Leakage Current ua	Second Set: Cap. MFD	Second Set: Dx %
18158	1-1	1.75	12.5	20.8	-	-	- See Note 1
18158	1-2	1.05	14.2	13.2	-	-	-
18159	2-1	0.37	12.1	4.4	1.50	12.4	4.9
18159	2-2	0.31	12.6	4.4	1.60	13.0	5.1
18160	3-1	0.32	11.5	4.8	1.69	11.9	5.3
18160	3-2	0.30	12.1	4.6	1.59	12.4	5.4
		VDC=6.0	VDC=6.0 VAC=0.5 peak to peak at f=120 cps		VDC=15.0	VDC=15.0 VAC= 0.5 peak to peak at f=120 cps	
MIL-C-62B Requirements:							
CE10C500C (50 MFD,*5 VDC)		2.0	50 -10% +100%	25	N.A.	N.A.	N.A.
CE10C100E (10 MFD,15VDC)		N.A.	N.A.	N.A.	2.5	10 -10% +100%	25

Notes:
1. --- indicates measurement not performed as units are 6 VDC items
2. N.A. indicates requirement not applicable
3. All leakage current measurements performed 24 hours after a 30-minute reforming period at the indicated DC voltages
4. * indicates smallest capacitance listed under the indicated voltage rating

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TEST RESULTS
Metallized Paper Capacitors

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Initial Measurements

MCN Part No.	Mat. Lab. Specimen No.	Measurement Terminals	Cap. MFD	Dx %	I.R. Megohms	at 25°C in Megohms for Characteristic M rating 150 VDC 200 VDC	400 VDC 600 VDC
18183	4	1 and 2	0.483	0.42	9,400	1,000	2,000
		3 and 2	0.470	0.42	11,800	1,000	2,000
		1 and 3	0.239	0.37	22,000	1,500	3,000
18184	5	1 and 2	0.505	0.43	9,600	1,000	2,000
18185	6	1 and 2	0.240	0.38	19,000	1,500	3,000
18177	10-2	1 and 2	1.067	0.52	-		
18177	10-3	1 and 2	1.027	0.52	-		
			f= 1 kc.		VDC=50		
18186	7	1 and 2	1.87	0.49	6,800	250	500
18175	8-1	1 and 2	1.87	0.50	7,900	250	500
18175	8-2	1 and 2	2.14	0.58	7,400	250	500
18176	9-1	1 and 2	4.14	0.50	6,100	125	250
18176	9-2	1 and 2	4.05	0.45	7,100	125	250
18177	10-1	1 and 2	1.85	0.47	7,600	250	500
18177	10-2	1 and 2	1.08	0.44	8,500	500	1,000
18177	10-3	1 and 2	1.04	0.49	8,100	500	1,000
			f= 60 cps		VDC=50		
			VAC = 1.0 rms				

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All styles in Characteristic M	± 10% or ± 20% tolerance	1.0 max. at 25°C	rated VDC or 500 VDC whichever is less

Notes: -- indicates measurement not performed as this unit was previously measured following 60 cps cap. and Dx measurements